Space Weather Forecast

Issued on Monday, 19 December 2022 at 01:01 Local

This forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Moderate-class X-ray flares likely. Slight chance of Minor Geomagnetic Storms until midweek.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been low over the past 24 hours, with occasional mid-ranking Common-class flares observed, peaking at 18/1010UTC - with this event associated with a sunspot group in the southwest of the Sun, but with many of the others associated with a large sunspot region in the northeast. This second sunspot group showed the most notable growth tendency over the 24 hours, with significant development in its trailing and intermediate spots. This group now covers a significant span, although it may be better described as two regions, with both difficult to discern fully at present given their proximity to the northeastern horizon.

Figure 1: Sources of the UTC weekend's X-ray flare activity of Common-class and above, with a departing sunspot group (in the southwest) and an arriving one (in the northeast) the main foci of activity. Image courtesy of SIDC ROB.

The above were two of up to nine sunspot regions on the current Earth-facing side. Growth in other regions was generally more limited however.

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There remain numerous 'filaments' (arcs of plasma) on the Sun, although none obviously erupted in the 24 hours. There were numerous Coronal Mass Ejections (CMEs) observed in the period, with six analysed thus far. Of these, four were considered far-sided western solar hemisphere events, one was tied to the 18/1010UTC flare but was directed west and north of the Sun-Earth line despite its southern hemisphere origins. The sixth a narrow eastward directed CME, with an uncertain source. In all cases, these were off the Sun-Earth line. No new Earth-directed CMEs were therefore in evidence in the period, although given the cadence of new emissions, further CMEs are expected to materialise on coronagraphs in the coming hours.

Solar Wind / Geomagnetic Activity: Solar winds followed a slow regime for much of the period, but with a slight enhancement observed in the UTC evening of an as yet uncertain provenance. Possible explanations include either a fore-running increase in density (a Co-rotating Interaction Region or CIR) in advance of a fast wind, or perhaps the 15 December CME passing close by.

The solar wind speed oscillated slightly about Background levels, with a late slight increase. The number of particles in the solar wind was near the long-term average, with a similar late increase to approach slightly elevated levels. Of more significance, the magnetic field associated with these particles showed a rising tendency into slightly elevated territory, although the north-south component remained more modest in scope.

The net effect of the above solar wind measures was nevertheless for provisionally quiet geomagnetic activity throughout, peaking late in the 24 hours as the solar wind magnetic field increased.

Energetic Particles / Solar Radiation: No solar radiation storms were observed in the period.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is likely to remain at moderate levels, with up to nine sunspot regions on the Sun at present. Successive departures over the western solar horizon through the period may be compensated for by hints of large arriving regions in the east, although this aspect of the forecast is lower confidence, and for now the risk is held constant throughout.

Solar Wind / Geomagnetic Activity: Up to two CMEs from 14 and 15 December have now most likely passed 1AU to no effect at Earth, although the latter may still arrive as a glancing blow with muted effects very early on day one, Monday 19 December.

The forecast otherwise comprises two fast wind streams, with the first imminent and perhaps offering a slight chance of G1 on Monday 19 December. After a lull into Tuesday, a second fast wind may arrive before midweek to give the peak risk of G1 for the four-day period, albeit still a small risk given our proximity to the semi-annual minimum potency of coronal holes around the solstice. The most reliably quiet day is now perhaps Thursday 22 December as the second fast wind matures.

Energetic Particles / Solar Radiation: No solar radiation storms are expected, although there is a slightly raised risk given the proximity of a large recently active sunspot near the better-connecting western solar horizon (with any solar radiation storm having an optimum route to Earth should an appropriate flare occur).

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Geomagnetic Storms:

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	20	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Radio Blackouts - X Ray Flares:

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	50	50	50	50
Very Active	R3 to R5 X	No	5	5	5	5

Solar Radiation Storms - (High Energy Protons):

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	15	10	10	10
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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